From Offline to Online: The Impact of Retail Enterprise Innovation and Transformation on Enterprise Performance

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Abstract

This paper briefly introduces the digital innovation, transformation, and performance of retail enterprises. Retail enterprises listed on the A-share market in China from 2015 to 2025 were selected as subjects, and indicator data related to digital innovation, transformation, and performance was collected. The performance of these retail enterprises was analyzed based on the indicator weights obtained by analytic hierarchy process. The Pearson correlation coefficient method was employed to preliminarily analyze the correlations between enterprise performance, the level of digital innovation and transformation, management expenses, and supply chain integration. Finally, the regression analysis method was used to further analyze the impact of the level of digital innovation and transformation on retail enterprise performance, as well as the mediating effect of management efficiency and supply chain integration. The results showed that digital innovation and

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transformation had a significant positive impact on retail enterprise performance, management expenses and supply chain integration had mediating effects, and digital innovation and transformation could indirectly affect retail enterprise performance through these two mediating variables.

Keywords: Retail enterprise, digital transformation, enterprise performance, regression analysis.

1 Introduction

Digital infrastructure, represented by e-commerce, mobile payments, big data analysis, artificial intelligence (AI), and social media, not only reconstructs the relationship of "people, goods, and places" but also gives rise to a new paradigm of omni-channel retailing [1–3]. In this context, traditional brick-and-mortar retail enterprises are under double pressure. On the one hand, pure e-commerce enterprises are gradually eroding market share with their advantages of low cost, high efficiency, and the ability to provide personalized services. On the other hand, sudden public events have accelerated the process of consumers moving online, prompting traditional retailers to rethink their development paths [4]. As a result, the digital transformation from offline to online is no longer an option for traditional retailers, but an inevitable strategy for survival. However, this transformation is not simply about opening an online retail platform but rather involves a systematic innovation project such as business model reconstruction, organizational capability upgrading, technology system integration, and customer relationship reengineering [5]. Retail enterprises not only need to maintain their offline advantages but also need to deeply integrate digital technologies to build a closed loop of online and offline consumption. The investment in digital transformation innovation during this process needs to be translated into corporate performance to achieve sustainable development [6]. Analyzing the mechanism of influencing factors can provide an effective reference for the digital innovation transformation of retail enterprises. Zhang et al. [7] used the theory of technological innovation and dynamic capabilities and selected 4,054 listed companies with environment, society, and governance rating data that have achieved business integration to analyze the impact of digital transformation on enterprises. Li and Fei [8] studied the logic and mechanism of the impact of network embeddedness on corporate performance and analyzed the benefits of digital transformation for corporate development. Li and Li [9] used a fixed-effect model and computer software to conduct

big data analysis on manufacturing enterprises to explore the impact of tax cuts on corporate performance and further explore the moderating role of digital transformation. This paper briefly introduced the digital innovation, transformation, performance of retail enterprises, and then analyzed retail enterprises listed on the A-share market in China from 2015 to 2025.

2 Case Study

2.1 Data Collection

Retail enterprises listed on the A-share market in China from 2015 to 2025 were selected as subjects. The reason is that listed enterprises need to disclose financial reports regularly and it is relatively easier to collect their indicator data for analyzing influence factors. First, retail enterprises whose financial reports are marked or marked as special treatment (ST) multiple times within the study time range, that are in a delisted state, whose key indicator data is missing or unavailable in their financial reports, or with a continuous data record of less than five years were excluded. After screening, 80 retail enterprises were selected as research subjects, totaling 755 observation samples.

Model variables used to analyze the impact of digital innovation and transformation of retail enterprises on enterprise performance are shown

Table 1 Variables of the model

Variable Type	Variable Name	Symbol	Data Source
Explained variable	Retail enterprise performance	Com	Annual financial report (AHP comprehensive calculation)
Explanatory variable	Digital innovation and transformation level [10]	Dig	Annual report text (word frequency statistics)
Mediating variables	Management expenses	ME	Annual financial report
	Supply chain integration	SCI	Annual financial report (supplier/client structure)
Control variables	Enterprise size	$Lnsize$	Annual financial report (CSMAR database)
	Monetary funds [11]	$Lnmon$	Annual financial report
	Top 10 shareholders' shareholding ratio	$Top10$	Annual financial report
	Duration of listing	Age	CSMAR database
	Number of executives	Man	Annual financial report
	Cash ratio	CR	Annual financial report

in Table 1. The explained variable is retail enterprise performance. This indicator variable was obtained through the analytic hierarchy process (AHP) method by conducting comprehensive weighted calculations on the nine indicators in the indicator layer of Table 2. The reason for choosing the AHP method to measure the performance of retail enterprises is that enterprise performance is a multi-dimensional concept. A single indicator is unable to comprehensively reflect the overall operating situation of an enterprise. The profitability in the criterion layer directly reflects the revenue-generating ability of an enterprise, the debt paying capacity reflects the financial safety margin of an enterprise, the operational capacity measures the efficiency of enterprise asset use, and the growth capacity reflects the development potential of an enterprise. These four aspects together constitute a three-dimensional evaluation of enterprise performance.

The explanatory variable is the level of digital innovation and transformation, which can be obtained using word frequency statistics. The specific operational steps are as follows: 1. Extract the text content from the annual reports, board reports, and management team discussion and analysis of the sample enterprises; 2. Build a keyword dictionary related to digital innovation transformation; 3. Conduct keyword search and frequency statistics for the annual report text of each enterprise, and use the total frequency of keywords as the original score of the enterprise's digital innovation transformation level in that year; 4. Considering the differences in the length of annual texts of different enterprises, a standardized processing method of "keyword frequency per thousand words of the text" was adopted to obtain the digital innovation transformation level indicator of the enterprises. The theoretical basis for this method is that the annual reports of enterprises and the management team discussions have a high degree of strategic orientation, reflecting the strategic focus and resource allocation direction of the enterprises. Therefore, the word frequency can be used to describe the enterprise's digital investment level more objectively.

The mediating variables include management expenses and supply chain integration. Management expenses reflect the efficiency of enterprise management. In this study, the ratio of management expenses to operating income was used to measure the level of management efficiency. The higher this ratio is, the higher the administrative management costs that the enterprise needs to bear to maintain its operation, and the lower the management efficiency. During the digital transformation of enterprises, the purpose of introducing digital technology is to optimize management processes and improve management efficiency. Therefore, management expenses may be

Table 2 Hierarchies and indicators for measuring retail enterprise performance

Target Layer	Criterion Layer	Indicator Layer	Reason To Choose	Data Source
Retail enterprise performance	Profitability	Operating profit margin	Measure the profitability of the main business, and it is the fundamental indicator for the survival of an enterprise.	Annual financial report
		Return on net assets	Reflect the return level of shareholders' equity and embody the efficiency of capital utilization	Annual financial report
		Net profit margin on total assets	Measure the comprehensive profit efficiency of all the assets of an enterprise	Annual financial report
	Debt paying capacity	Debt-to-asset ratio	Measure the financial leverage and long-term debt repayment risks of an enterprise	Annual financial report
		Quick ratio	Measure an enterprise's short-term debt-paying ability, and it is particularly important for the capital turnover of the retail industry.	Annual financial report
	Operational capacity	Total capital turnover ratio	Measure the overall capital operation efficiency of an enterprise	Annual financial report
		Current asset turnover ratio	Directly reflect the inventory and cash turnover rate of retail enterprises	Annual financial report
	Growth capacity	Total operating revenue growth rate	Reflect an enterprise's ability to expand its scale and its business growth potential	Annual financial report
		Growth rate of total assets	Measure the overall scale of an enterprise	Annual financial report

the mediating path between digital transformation and enterprise performance. Supply chain integration is the sum of the procurement ratio and the sales ratio of the top five suppliers of the enterprise. The higher this value, the higher the concentration of procurement and sales segments, and the closer the collaboration relationship with core suppliers and core

customers. During the enterprise transformation process, the investment in digital technology can reduce information asymmetry between supply chain links, improve inventory turnover efficiency, demand prediction accuracy, and logistics coordination ability, so supply chain integration may be the mediating path between digital transformation and enterprise performance.

A total of six control variables were selected. The reasons for selection were as follows. 1. Enterprise size: larger enterprises have a stronger resource foundation and risk-resistance capability during digital transformation, but also have more complex organizational coordination costs. 2. Monetary funds: the more abundant the enterprise's monetary funds are, the stronger its investment ability in digital transformation, and it also has a financial buffer for reorganization to cope with the risks of transformation. 3. Top 10 shareholders' shareholding ratio: the higher the concentration of equity, the stronger the supervisory and intervention ability of the major shareholders in the strategic decision-making of the enterprise, and it can affect the willingness and pace of digital transformation. 4. The duration of listing: the longer the listing time of the enterprise, the more mature its governance structure is, but there are also greater organizational inertia and path dependence. 5. Number of executives: the scale of the management team reflects the complexity of the enterprise's organization and the management levels, which may affect the decision-making efficiency and transformation speed. 6. Cash ratio: it can measure the short-term debt-paying ability and financial flexibility of the enterprise, and has a direct impact on the space for transformation investment. The hierarchies and indicators of the AHP method employed to compute the performance of retail enterprises are shown in Table 2.

2.2 Analytical Methods

The AHP method measured the performance of retail enterprises, and the hierarchical structure is shown in Table 2. In the quantitative calculation, weights were assigned to the primary and secondary indicators, and the evaluation steps of the weights are as follows.

(1) A hierarchical structure model for assessing the performance of retail enterprises was built, i.e., the structure consisting of the target, criterion, and indicator layers shown in Table 2.
(2) A judgment matrix [12] was built for each level to determine the relative importance of each indicator, thereby obtaining indicator weights. The construction of the judgment matrix followed the following process. First, pairwise comparisons were conducted among each element within

the same level. Taking the criterion layer as an example, the elements of profitability, debt paying capacity, operational capacity, and growth capacity were compared pairwise. Five experts independently evaluated the relative importance of each pair of elements using the 1–9 scale method. A scale value of 1 indicates that the two elements are equally important. The larger the scale value, the more important the former element is compared to the latter element. The results of pairwise comparisons of each element are summarized into a judgment matrix, $A = (a_{ij})_{n\times n}$, where a_{ij} is the importance scale value of element i relative to element j, $a_{ij} > 0$ and $a_{ij} = 1/a_{ji}$, and n is the number of elements for pairwise comparison. The independent assessment results of each expert formed their judgment matrix. To further enhance the objectivity of the judgment matrix, the geometric mean of the scale values corresponding to the positions in the matrix given by the experts was calculated to obtain the final judgment matrix.

The weight vector calculation and consistency test were carried out [13]. The weight vector was calculated using the eigenvector method. First, the maximum eigenvalue and the corresponding eigenvector of the judgment matrix were calculated. The normalized eigenvector was the weight vector of each element. At the same time, the consistency of the judgment matrix was calculated. First, the consistency indicator and the consistency ratio were calculated. The formulas are:

$$\begin{cases} CI = \dfrac{\lambda_{\max} - n}{n-1} \\ CR = \dfrac{CI}{RI} \end{cases}, \tag{1}$$

where CI is the consistency indicator, CR is the consistency ratio, RI is the average random consistency indicator, which can be obtained by looking up the table, $\lambda_{\max}$ is the maximum eigenvalue of the judgment matrix, and n is the number of elements for pairwise comparison. When CR is less than 0.1, the judgment matrix passes the consistency test; otherwise, the matrix will be returned to the experts for re-evaluation. After passing the consistency test, the weight was summarized layer by layer using the product weighting method.

After obtaining the weights of the indicators of the retail enterprise performance hierarchy, the performance of each sample was computed based on the collected sample data. Then, the Pearson correlation coefficient method [14]

was used to conduct a preliminary correlation analysis of the variables in the analysis model in Table 1, and then the regression analysis model was used for analysis [15]. The regression benchmark model is:

$$Com_{it} = \beta_0 + \beta_1 Dig_{it} + \sum_{j=1}^{n} \beta_{j+1} Controls_{itj} + \delta_i + \mu_i + \varepsilon_{it}, \quad (2)$$

where Com_{it} is the performance of enterprise i in year t, β_0 is a constant term, δ_i and μ_i are the fixed and time effects of enterprise i, Dig_{it} is the level of digital innovation and transformation of enterprise i in year t [16, 17], β_1 is the regression coefficient of Dig_{it}, $Controls_{itj}$ is the j-th control variable of enterprise i in year t, β_{j+1} is the regression coefficient of $Controls_{itj}$.

The mediating effect model is:

$$\begin{cases} Med_{it} = \alpha_0 + \alpha_1 Dig_{it} + \sum_{j=1}^{n} \alpha_{j+1} Controls_{itj} + \delta_i + \mu_i + \varepsilon_{it} \\ Com_{it} = \delta_0 + \delta_1 Dig_{it} + \delta_2 Med_{it} + \sum_{j=1}^{n} \delta_{j+2} Controls_{itj} + \delta_i + \mu_i + \varepsilon_{it} \end{cases}, \quad (3)$$

where Med_{it} is the mediating variable of enterprise i in year t, α_0 and δ_0 are constant terms, α_1 and δ_1 are regression coefficients of Dig_{it}, α_{j+1} and δ_{j+2} are the regression coefficients of $Controls_{itj}$, and δ_2 is the regression coefficient of Med_{it}. When α_1, δ_1, and δ_2 are significant, it indicates that there is a mediating effect in the mediating variables of the mediating effect model.

2.3 Analysis Results

The subjective weighting approach was utilized to determine the weights of the performance hierarchy indicators. Five experts were invited to assess the relative importance of each pair of indicators in the hierarchy, as shown in Table 3. It can be seen that among the primary indicators of the criterion layer, the weights for profitability, debt paying capability, operational capability, and growth capability were 0.3927, 0.2114, 0.2081, and 0.1877, respectively.

After obtaining the performance using the weights of the performance hierarchy indicators combined with the collected indicator data, the Pearson correlation coefficient method was employed to conduct a preliminary analysis of the correlations among performance, the level of digital innovation

Table 3 Weights of performance hierarchy indicators for retail enterprises

Primary Indicator	Weight	Secondary Indicator	Weight
Profitability	0.3927	Operating profit margin	0.4749
		Return on net assets	0.2974
		Net profit margin on total assets	0.2277
Debt paying capacity	0.2114	Debt-to-asset ratio	0.5166
		Quick ratio	0.4834
Operational capacity	0.2081	Total capital turnover ratio	0.5819
		Current asset turnover ratio	0.4181
Growth capacity	0.1877	Total operating revenue growth rate	0.5456
		Growth rate of total assets	0.4544

Table 4 Results of Pearson correlation coefficient analysis

	Com	Dig	ME	SCI
Com	1			
Dig	0.016**	1		
ME	−0.111**	−0.005**	1	
SCI	0.087**	0.157**	0.211**	1

Note: ** indicates significant at the 1% level.

and transformation, management expenses, and supply chain integration. The results are shown in Table 4. The performance was significantly positively correlated with the level of digital and innovation transformation and supply chain integration, and significantly negatively correlated with management expenses.

Table 5 presents the net effect of digital innovation transformation on enterprise performance. Model 1 indicates that for every 1-unit increase in digitalization level, the average enterprise performance increased by approximately 0.012 units, and this result was highly statistically significant ($p < 0.01$), preliminarily confirming that digital transformation can indeed generate profits. Model 2, after introducing control variables such as enterprise size and monetary funds, the explanatory power (R^2) of the model increased from 0.631 to 0.697, indicating that these factors also had an impact on performance. Among them, the number of executives was significantly negatively correlated with performance, meaning that an overly large management team may actually lower efficiency. This suggests that enterprises should pay attention to simplifying the management structure during the transformation process.

Table 6 reveals how digital transformation affects enterprise performance – through two intermediate paths: management expenses and supply

Table 5 Benchmark model regression results

Variable	Model 1 (Com)	Model 2 (Com)
Dig	0.012**	0.015**
$Lnsize$	/	0.013**
$Lnmon$	/	0.003**
$Top10$	/	0.001**
Age	/	0.004
Man	/	−0.002**
CR	/	0.023**
R^2	0.631	0.697

Note: ** indicates significant at the 1% level.

Table 6 Regression results of the mediating effects model for management expenses and supply chain integration

Variable	Model 3 (ME)	Model 4 (Com)	Model 5 (SCI)	Model 6 (Com)
ME	/	−0.291**	/	/
SCI	/	/	/	0.014**
Dig	−0.011**	0.008**	1.695**	0.013**
$Lnsize$	−0.010	−0.018**	−3.256**	−0.016**
$Lnmon$	−0.012**	−0.002	0.784	0.003
$Top10$	−0.001	0.001**	0.031	0.001**
Age	−0.006	0.001	−1.804	0.004
Man	0.001	−0.001	−0.634**	−0.001
CR	0.010**	0.024**	2.061**	0.023**
R^2	0.785	0.724	0.782	0.694

chain integration. Model 3 shows that for every 1-unit increase in digitalization level, management expenses decreased significantly by approximately 0.011 units, indicating that digital technologies, such as AI decision-making and automated processes, do indeed enabled enterprises to "save money" and reduce administrative management costs. Model 4 further indicates that for every 1-unit decrease in management expenses, enterprise performance increased by approximately 0.291 units, confirming the saying "what you save is what you earn". Model 5 shows that for every 1-unit increase in digitalization level, the degree of supply chain integration increased significantly by approximately 1.695 units, meaning that digitalization can help enterprises establish closer collaboration relationships with upstream and downstream suppliers and customers. Model 6 indicates that for every 1-unit increase in supply chain integration, enterprise performance increased by approximately 0.014 units, demonstrating that "cooperative efforts" created more value

than "individual efforts". In summary, digitalization jointly promotes performance growth through two paths: "saving internally" (reducing management expenses) and "collaborating externally" (strengthening the supply chain).

3 Discussion

Driven by the global digital economy wave and profound changes in consumer behavior, the digital innovation and transformation of retail enterprises has evolved from a strategic option to a necessity for survival. While some enterprises have achieved performance improvements through digital innovation and transformation, a large number of traditional retail enterprises have experienced profit declines, increased internal friction within the organization, and even strategic disorientation after investing huge costs in transformation. The paradoxical scenario shows that digital innovation and transformation require rigorous, quantitative, and cause-and-effect orientation research. This paper used the regression analysis method to analyze the impact of digital innovation and transformation on enterprise performance. The AHP was first used to calculate the performance, and then the benchmark model and mediating effect model analyzed the impact of digital innovation and transformation on enterprise performance and the mediating effects of two mediating variables, management costs and supply chain concentration.

The Pearson correlation coefficient analysis found significant correlations among retail enterprise performance, digital innovation and transformation level, management efficiency, and supply chain integration, preliminarily indicating that digital innovation and transformation level, management expenses, and supply chain integration all have an impact on enterprise performance. The subsequent regression analysis results further verified the significant positive impact of digital innovation and transformation, and the calculation results of the mediating effect model also verified the mediating effect between management expenses and supply chain integration. Digital innovation and transformation can indirectly affect retail enterprise performance through these two mediating variables.

Reasons for the above results were analyzed. Enterprises will widely apply digital technologies in their management during the process of digital innovation and transformation. They will use digital technologies to more effectively capture and analyze consumer data, improve business process efficiency, expand product sales channels, and thereby promote the growth of enterprise performance. In the retail market, there is intense industry competition and diverse consumer demands, which impose extremely high

requirements on the management capabilities of retail enterprises. With the help of digital technology, enterprise managers can analyze market changes more efficiently, manage customer relationships, and reduce management costs, thereby promoting the improvement of enterprise performance. Therefore, digital innovation and transformation has a significant negative impact on management costs. In the entire retail industry process, digital technology enables enterprises to achieve efficient collaboration between upstream and downstream suppliers and customers, and accurate matching of warehousing and demand, thereby reducing costs and improving enterprise performance. Therefore, digital innovation and transformation has a significant positive impact on supply chain integration, and supply chain integration has a mediating effect. Digital innovation and transformation can thereby indirectly affect enterprise performance.

To further illustrate the impact of digital transformation on the performance of retail enterprises, here is a specific case analysis. Chongqing Department Store Co. Ltd. (renamed Chongqing Chongbai Technology Group Co. Ltd. in 2026) is a long-established retail leader in the southwestern region, with four business segments: department stores, supermarkets, electrical appliances, and auto trade. Facing the challenges of online diversion and differentiated consumer demands, Chongbai utilized AI technology to build a full-chain intelligent system covering marketing, supply chain, store operations, and management decision-making.

In terms of member operation, Chongbai has horizontally integrated the major business types of department stores, supermarkets, electrical appliances, and auto trade, and vertically connected its self-operated platform with public domain channels such as Douyin, JD.com, and Meituan, incorporating member identities, transaction records, and behavioral preferences into a unified data middle platform. Relying on the AI profiling system to achieve precise reach, during the 6th Centennial Chongbai Shopping Festival, 2.49 million members were reached at different levels, with 205,000 new members added. The new members contributed over 63 million yuan in sales. By 2025, the membership scale of Chongbai had exceeded 31 million, and the total member sales through all channels reached 14.9 billion yuan, accounting for nearly 52% of the total sales. Online sales exceeded 2 billion yuan, with a year-on-year growth of over 10%.

In terms of supply chain and store operation, after Chongbai launched the intelligent replenishment system, it achieved precise inventory preparation at the hourly level, and the out-of-stock rate of supermarket stores dropped from 26.4% to 2%. Smart store solutions such as electronic price tags and mobile

phone grid diagrams have realized the full-process digital management of headquarters mapping, store execution, and intelligent inspection. Overall, Chongbai has achieved a quantitative increase of 2.31 percentage points in gross profit margin through digital transformation.

4 Conclusion

This paper analyzed retail enterprises listed on the A-share market in China from 2015 to 2025. The indicator data related to digital innovation and transformation and enterprise performance was collected. First, the enterprise performance was evaluated using the indicator weight obtained by the AHP method. Then, the Pearson correlation coefficient method was employed to preliminarily analyze the correlations between enterprise performance, the level of digital innovation and transformation, management expenses, and supply chain integration. Finally, the regression analysis method was used to further analyze the impact of the level of digital innovation and transformation on enterprise performance, as well as the mediating effects of management efficiency and supply chain integration. In the hierarchy of enterprise performance, the weights for profitability, debt paying capacity, operational capacity, and growth capacity were 0.3927, 0.2114, 0.2081, and 0.1877, respectively. Pearson correlation analysis found that enterprise performance had significant correlations with the level of digital innovation and transformation, management expenses, and supply chain integration. Digital innovation and transformation had a significant positive impact on enterprise performance, while management expenses and supply chain integration had a significant mediating effect. The former had a significant negative impact on retail enterprise performance, while the latter had a significant positive impact.

The main drawback of this article lies in the fact that the data used for the analysis is entirely from Chinese sources. As a result, the analysis results are geographically limited and may not be applicable to retail enterprises in other countries.

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